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Volta, the German Controversy on Physics and *Naturphilosophie* and his Relations with Johann Wilhelm Ritter

A characteristic of German science around 1800 is the violent debate about concepts and methods between the supporters and opponents of a certain philosophy of nature that is generally designed by the German term of *Naturphilosophie*.[1] In the early nineteenth century, physicists who were arguing in the spirit of *Naturphilosophie* were defined as a community of people that could be sharply distinguished from the "normal" or traditional physicists. This was especially the standpoint of observers from outside Germany.[2] But also German physicists spoke of "so-called philosophers of nature who declared that dualism is the principle of order everywhere in physics and chemistry".[3]

The philosopher Friedrich Wilhem Schelling, who had given the term of "spekulative Physik"[4] to the kind of science by which he wanted to overcome traditional experimental physics and chemistry, is often considered as the ideological forerunner of this group of scientists.

Another way of dividing German physicists into different camps was the distinction between "Atomisten" and "Dynamisten", atomists believing in the existence of matter, including imponderable matter, and dynamists believing only in

[1] For more details, see the article of von Engelhardt in this volume. With regard to physics, see CANEVA (1997).

[2] See OERSTED (1813). On p. XIV, the translator apologises for translating such an eccentric essay into French and mentions that *Naturphilosophie* was widely considered as having a detrimental influence on empirical sciences. ("Depuis peu on a fait aux Allemands le reproche très-grave de vouloir porter dans les sciences les spéculations, et pour ainsi dire les rêves d'une imagination exaltée. [...] Il faut seulement avouer que la philosophie connue en Allemagne sous le nom de philosophie de la nature (naturphilosophie), et qui règne dans quelques parties de cette contrée, ne pourra avoir qu'une influence très-funeste sur les sciences, sur-tout celles d'observation").

[3] GILBERT (1807), p. 419: "Bekanntlich ist Polarität das Losungswort der so genannten Natur-Philosophen, und derer, welche mit Herrn Ritter 'den Dualismus zum ordnenden Princip aller Physik und Chemie' aufwerfen wollen".

[4] This expression appears in the title of his journal *Zeitschrift für spekulative Physik*, 1800-01.

forces. The dynamists considered another prominent philosopher as the founder of their doctrine: Immanuel Kant with his *Metaphysische Anfangsgründe der Naturwissenschaften* of 1786. But the closer we look at the sources, the more difficult it is to categorise individual physicists according to such a pattern. Particularly problematic is the identification of dynamists with *Naturphilosophie* – there were scientists who believed in polarity without denying the existence of matter, and there were dynamists who cannot be blamed for excessive speculation.

One should also keep in mind that the scientists who were considered as being influenced, or spoiled, by *Naturphilosophie* were not at all such a homogenous group as is suggested by the disparaging remarks and pamphlets of their opponents. And for the sake of precision, it must be stressed that the influence of *Naturphilosophie* on physics and chemistry was not limited to German speaking countries; it extended from Copenhagen (Hans Christian Ørsted) to Budapest (Jakob Joseph Winterl).

As an external observer who was in close touch with a great number of German scientists,[5] and as a regular reader of German periodicals, Volta was fully aware of the disagreement and mutual hatred that opposed many of his colleagues in northern countries. But a reader of his writings and correspondence will come to the conclusion that he was not very interested in this "querelle d'Allemand".

With one exception, Volta's German correspondents were all strictly opposed to the "so-called philosophers of nature". Names of such prominent followers of Schelling's and Kant's natural philosophy like Seebeck, Ørsted, Schweigger, and Winterl are missing in the index of Volta's works, and when others like Adolf Ferdinand Gehlen, Johann Carl Fischer and Georg Friedrich Hildebrandt are mentioned, we merely learn that Volta had ordered their publications from a German bookseller.

Volta's greatest admirers and strongest supporters in Germany were Ludwig Wilhelm Gilbert (1769-1824) and Christoph Heinrich Pfaff (1773-1852). Both of them bluntly expressed their opinion about the followers of *Naturphilosophie* in their letters to Volta. The first remark of this kind can be found in a letter by Pfaff of December 1801, where he complains about "some German metaphysicians" who do not give up their "abstract and unintelligible formulas".[6] But it was especially Gilbert, professor of physics at Halle and well known as the editor of the journal *Annalen der Physik*, who complained to Volta about the decline of German physics and the growing influence of *Naturphilosophie* in a letter of 1807:

> As for the state of physics in Germany, it is very regrettable that the disastrous war [an allusion to the Napoleonic wars] seems to be harmful especially to those parts of Germany where natural science flourished in a spirit of ambition and of true research, i.e. the Prussian states, Saxony and Hanover. There is a remarkable difference between northern and southern Germany. In the latter, a deplorable spirit of speculation and

[5] See VOLPATI (1927).
[6] Pfaff, letter to Volta [Dec. 2, 1801], in *VE*, IV, 1211, pp. 114-7, see p. 115.

> mysticism has spread in physics, and even such men who used to do solid and skilful experimental work have become victims of this new trend. Munich now seems to be the centre of these fantasies, after the decline of the University of Würzburg.
> [...]
> In southern Germany, especially medical doctors join in this chorus of fantasy, mysticism, and speculation. You will find an excellent description of this situation in the booklet *Ueber Naturphilosophie* by professor Link from Rostock (who is well-known for his journey to Portugal). It is a penetrating description of all the strange approaches "to construct nature" (as they call it), and the author demonstrates that the way to true natural science is just the opposite one. More about this in my next letter.[7]

In the same letter, Gilbert describes the theories of the Budapest professor Jakob Joseph Winterl (1732-1809) as "imagination, woven of outdated dreams and chimeras".[8] Winterl's *Prolusiones ad chemiam seculi decimi noni* which had been presented to the German speaking public by Hans Christian Ørsted[9] were highly estimated in these circles as a new chemistry in the spirit of *Naturphilosophie*.

One year later, in March 1808, Gilbert offered his latest book to Volta, along with a letter in which he says:

> Please do not refrain from reading my book for the reason that it deals with fantasy and imagination. It will give you a rather precise illustration of the philosophy of a sect that tried to invade physics by force. It was impossible to argue against those people in less aggressive terms than I did. On page 109 you will find a little list of all the many sins that R. has committed in physics.[10]

[7] Gilbert, letter to Volta [1807], in *VE*, V, 1556, pp. 109-12, see pp. 110-1: "Was den Zustand der Physik in Deutschland betrifft, so ist es sehr zu bedauern, dass der unglückliche Krieg grade die Gegenden um ihren Flor zu bringen scheint, wo die Naturwissenschaften mit dem mehrsten Eifer und mit dem wahren Geiste des Forschens getrieben wurden. Das heisst die preussischen Staaten, Sachsen und Hannover. Es ist darin ein grosser Unterschied zwischen dem nördl. und dem südlichen Deutschland. In lezterem hat ein Geist der leidigen Speculation und des Mysticismus in der Physik um sich gegriffen, der sich selbst Männer die sonst redlich und geschickt experimentirten, bemächtigt hat. Besonders scheint jezt München (seitdem die Universität Würzburg so gut als eingegangen ist) der Sitz dieser Schwärmerey zu seyn. [...] Im südlichen Deutschland stimmen besonders die Aerzte in diesen Ton der Schwärmerey, des Mysticismus und der Speculation mit ein. Vortrefflich redet darüber Prof. Link in Rostock (der durch seine Reise nach Portugal bekannt ist) in einem kleinen Schriftchen: *Ueber Naturphilosophie* von Link. Er würdigt sehr gut alle wunderbaren Versuche die Natur zu construiren, wie es die Herren nennen, und zeigt, dass der Weg wahrer Naturforschung grade der entgegengesezte sey. Etwas davon schicke ich Ihnen in meinem nächsten Briefe".

[8] *Ibid.*, p. 111: "Gewebe von längst vergessenen Träumereyen und Chimären".

[9] OERSTED (1803).

[10] Gilbert, letter to Volta [March 8, 1808], in *VE*, V, 1565, pp. 124-7, see p. 125: "Ich ersuche Sie sich von der Lectüre meiner Schrift dadurch nicht abhalten zu lassen, dass sie Schwärmereyen betrifft. Sie werden sich daraus eine ziemlich anschauliche Idee von der Denkungsart einer Secte machen können die sich mit Gewalt in die Physik eindrängen wollte, und gegen die sich nicht

"R." stands for the only German physicist who, as a prominent member of the sect of the "Naturphilosophen", was well known to Volta: Johann Wilhelm Ritter (1776-1810), a physics student in Jena until 1804 and member of the Bavarian Academy in Munich after 1805.[11]

What are "the many sins that Ritter has committed in physics", according to Gilbert? If Volta followed Gilbert's recommendation to read page 109, he found this:

> Dualism, polarity, periodicity, galvanism, the general drive in organic and inorganic nature, in macrocosm and microcosm: it seems that such metaphysical views came into his mind during his experiments; but instead of bringing him closer to the truth, they lead him astray on rough and thorny ground. [...] Many of his experiments were not successful when they were performed by other physicists, and [...] they were declared products of imagination by Dr. Nauche, president of the galvanic society of Paris. [...] Mr. Ritter has also discovered that a suspended and pivoted needle, which has a positive electric charge on one end and a negative charge on the opposite end, will always align itself in a definite direction, and that it is influenced by a magnet. He has found as well that, without any external influence, metals are charged with electricity, and that they can keep this electricity for a certain amount of time. Mr. Erman has demonstrated that all this is completely wrong. Finally we must be grateful to Mr. Ritter for the discovery that every magnet is the equivalent of two different metals which are closely connected; that a magnet, like a pair of metals, is a source of electricity; and that several magnets can be combined in order to form a voltaic battery. He pointed out the immense perspectives that will result from the fact that the earth behaves like a big magnet. With the intention of confirming the truth of these assertions, Erman scrutinised all this with painstaking accuracy, but it turned out that all of Ritter's discoveries were pure imagination. [...] When a scientist is guided in such a miraculous way by metaphysical views that come into his mind, and when he follows these guidelines with imperturbable confidence – how can we be surprised that he and his co-experimenters [...] will make discoveries like those described above?[12]

sanfter sprechen liess, als ich gethan habe. Seite 109 finden Sie ein kleines Verzeichnis der vielen physikal. Sünden, welche R. auf sich geladen hat".

[11] For Ritter's biography, see Klaus Richter's introduction in RICHTER (1988).

[12] The complete German text reads: "Dualismus, Polarität, Periodicität, Galvanismus, das allgemeine Triebrad in der belebten wie in der todten Natur, im Makrokosmus wie im Mikrokosmus; das sind höhere Ansichten, welche Herrn Ritter bei seinen Versuchen schon manchmahl entgegen gekommen zu seyn, ihn aber, statt zur Wahrheit empor zu heben, in einen dornigen und schwierigen Boden gelockt zu haben scheinen. Schon früh glaubte er in den Wirkungen des Galvanismus auf die Sinne Gegensätze, und dann wieder Gegensätze mehrerer Art in diesen Gegensätzen zu finden; viele seiner Versuche gelingen aber andern Physikern nicht, und die galvani'sche Societät in Paris erklärte sie, nach vieler Mühe, die sie sich mit ihnen gegeben hatte, durch ihren Präsidenten, den Dr. Nauche, für Geschöpfe der Phantasie. In der Erregbarkeit der muskulösen Organe durch einerlei galvani'sche Erreger entdeckte späterhin Herr Ritter einen doppelten Gegensatz in Hinsicht der Zeit, und in Hinsicht der Flexoren und Tensoren; gegen diese Gegensätze ist Herr Pfaff in Kiel aufgetreten, und hat es sehr wahrscheinlich gemacht, daß sie nicht in der Natur sind. Hr. Ritter entdeckte ferner, daß eine schwebende Nadel, die sich ungehindert drehen kann, wenn sie an dem einen Ende positiv, an dem andern negativ electrisch

In the letter, Gilbert says that Ritter's ideas are characteristic of the "Denkungsart einer Sekte", and we can see that the polemics in the quoted text is as well directed against Ritter's "co-experimenters" who share his reverence for the "entgegen kommende Ansichten" – the transcendental views of nature that guided his experiments.

Did Volta agree with Gilbert's sharp judgment about Ritter? We do not know. His answer to Gilbert's letter – if there was any – has not survived. But there are other sources with information about the relationship between Volta and Ritter, and I will now trace back this relationship until its beginning in 1797. As for the influence of Volta on Ritter's theories about the origin of galvanic electricity, I refer to the fundamental paper of Jürgen Teichman on this topic.[13]

Although Ritter was seven years younger than Gilbert, his connection with Volta was six years older than Gilbert's. In 1796, at a time when Gilbert was already extraordinary professor in Halle, the twenty-year-old Ritter had enrolled as a science student at the University of Jena. From the very beginning of his studies, he focussed his attention upon galvanism. He performed experiments at his own expense, outside the university, and presented them to a public of local amateurs who were members of the "Naturforschende Gesellschaft", and to other students who, under the influence of the Romantic movement, considered Ritter's demonstrations as a proof for the existence of a unifying link between all natural phenomena: galvanism. "Ritter is the knight, and the rest of us are the squires", is a famous characterisation of Ritter by the romantic poet Friedrich von Hardenberg,

ist, sich mit dem positiven Ende stets einer bestimmten Weltgegend zudreht, und daß ein Magnet auf sie wirkt; auch hat er entdeckt, daß Metalle, unabhängig von äußern Veränderungen, eine electrische Ladung anzunehmen, und eine Zeit lang zurück zu behalten vermögen; daß diesem allem nicht so sey, hat Herr Erman bewiesen. Endlich hat Herr Ritter die Entdeckung gemacht, daß jeder Magnet ein Aequivalent eines Paars mit einander verbundener heterogener Metalle ist, daß er wie diese Electricität liefert, und daß mehrere Magnete sich zu einer Voltaischen Batterie verbinden lassen, und er hat uns einen Blick in die unermeßlichen Aussichten thun lassen, die sich dadurch öffnen, indem die Erde als Magnet im Großen wirkt. Mit größter Sorgfalt und bestem Wunsche für die Realität der Entdeckung prüfte Erman, und fand nichts von dem allen. Nicht bloß in den Nordlichtern, auch in den Feuerkugeln, in den Meteorsteinen, ja selbst in den Gewittern hat Herr Ritter bestimmte Perioden gesehen; er hat sie später bei der Electricität und in der Voltaischen Säule, ja sogar beim Flackern der Flamme wieder gefunden, und besonders hat er in der Weingeistflamme drei Perioden mit ihren Unterabtheilungen sehr gut beobachtet, ja zum Theil sogar abgehört; und durch diese Perioden, glaubt er, sey ihm das große Zeitgesetz der Natur offenbart. – Wenn ein Naturforscher durch die höhern Ansichten, welche ihm entgegen kommen, schon so wunderbar geführt worden ist, und doch immer noch festen Vertrauens seinen Geleiterinnen nachfolgt; dürfen wir uns wundern, wenn er und Mitexperimentatoren, die mit gleicher Ehrfurcht für die entgegen kommenden Ansichten erfüllt sind, zu Entdeckungen von der Art gelangen, wie die vorstehenden Berichte sie uns schildern?" (GILBERT (1808), pp. 109-11).

[13] TEICHMANN (1977).

called Novalis.[14] But it would be a mistake to identify the quality of Ritter's research with the scientific standards of his public. His experiments were systematic and careful, and before he turned to practical galvanism, he had studied all the relevant literature on the subject in a tremendously short amount of time. He was perfectly acquainted with Volta's publications – especially with the three letters "On galvanism, or electricity excited by the contact of two different conductors" to professor Gren – the physics professor in the nearby university of Halle – published in Gren's *Neues Journal der Physik* in 1796. Another important scientist whose work on galvanism Ritter had studied was Alexander von Humboldt.

In the second year of his studies, Ritter published his first book, a treatise of about 200 pages with the title *Beweis, daß ein beständiger Galvanismus den Lebensproceß in dem Thierreich begleite* ("Proof that a permanent galvanism is combined with the vital process in the animal kingdom"). To a large extent, this book is a response to Volta's researches, and therefore it is not surprising that it is dedicated to "the great men F.A. von Humboldt and A. Volta".

The book is divided into two parts of very different length. In part I, Ritter describes his galvanic experiments and formulates the laws that he had found for their description. In the programmatic part of the introduction, he claims that his work is strictly empirical. It will not include any new hypotheses, but only conclusions drawn from observation and experience.[15]

In the empirical part of the *Beweis*, Volta could see that Ritter agreed with him in more than one respect. As for the origin of galvanic electricity, Ritter has always been a supporter of Volta's contact theory;[16] and he considered his new experiments as a perfect confirmation of Volta's laws of the galvanic chain. Like Volta, Ritter was convinced of the identity of electricity and galvanism; in a critical discussion of Humboldt's objections against this theory, he declares that even if Humboldt's observations were correct, his interpretation of the results was wrong: in reality, he says, there is no contradiction between Humboldt's experiments and Volta's theory.

Following Volta's example, Ritter had performed systematic experiments about the effect of the galvanic stimulus on the senses, especially on taste. He had found that, depending on the pole, electricity tasted like acid or alkali, and this observation was for him strong evidence of the link between galvanism and chemistry. An important argument in favour of his assertion that all life is accompanied by galvanism was the discovery that galvanic effects can occur in chains that contain only organic components.

In the second part of the book, which contains less than 20 pages, Ritter seems to forget the strict declaration of belief in empirical principles that he had formulated at

[14] Novalis to Caroline Schlegel, January 20, 1799, quoted in RICHTER (1988), p. 31: "Ritter ist Ritter und wir sind nur Knappen". It is a play on words: "Ritter" is the German word for "knight".
[15] RITTER (1798), pp. X-XI: "keine neue Hypothese über unsern Gegenstand, sondern bloße Erfahrungen und unmittelbare Folgerungen aus ihnen".
[16] See TEICHMANN (1977), p. 53.

the beginning. What he had promised in the title, he claims, is demonstrated by the existence of the three components of a galvanic chain in any living organism; hence the living body must be a complicated system of active and interconnected galvanic chains. Among the general rules drawn from the results of part I, we find the assertion that substances used in galvanic experiments can be used for medical purposes. The book ends with some risky speculations ("verwegen vorkommen müssende Muthmaßungen"), including the assertions that galvanism is the bond between body and soul, that there is no distinction between organic and inorganic nature: "What remains of the difference between the parts of the animal, the plant, and the stone? – Are they not all part of the all-embracing animal, Nature?"[17]

Finally all the galvanic experiments described in the book are interpreted as a confirmation of Ritter's belief in the unity of Nature that he had already expressed in the introduction: "A general law on Nature, still unknown, seems to spread its light on us".[18]

In July 1798, Ritter sent a copy of the book to Volta, accompanied by a long letter (24 pages, 20 pages in the *Edizione Nazionale* of Volta's works).

The letter provides comments upon certain passages of the book. Ritter explains why, in spite of his agreement with Volta concerning the identity of electricity and galvanism, he did not openly speak of *Electricität*: in this case, the book would immediately have been rejected by all those who were under the dominant influence of Humboldt's overwhelming authority; the use of the term *Galvanismus* was just a trick in order to bring the truth to the ears of the unsuspecting reader.[19] Much more bluntly than in the book, Ritter declares that Humboldt's arguments against the identity of electricity and galvanism are mistaken, because it is not at all evident that, as Humboldt had claimed, bones, the flame, hot glass, and rarefied air are insulators. He openly supports Volta's contact theory, and as an important result of his discovery of the formal identity of the electrical and chemical process, he describes some new experiments demonstrating that the electrical potential series corresponds to affinity tables in chemistry: in a galvanic chain, the metal with the positive charge has a stronger affinity to oxygen than the other metal.

As a supplement to the book, Ritter finally indicates some more experiments in order to prove that "galvanic action" is possible without organic components in the chain.

Ritter's arduous attempt to get recognition from Volta could have been the starting point of a stimulating exchange of ideas between the young, enthusiastic and original

[17] RITTER (1798), p. 171: "Wo bleibt denn der Unterschied zwischen den Theilen des Thieres, der Pflanze, dem Metall und dem Steine? – Sind sie nicht sämmtlich Theile des grossen All-Thiers, der Natur?".

[18] *Ibid.*: "Ein allgemeines bisher noch nicht gekanntes Naturgesetz scheint uns entgegen zu leuchten".

[19] Ritter, letter to Volta [July 17, 1798], in *VE*, III, 1095, pp. 385-406, see p. 386: "Ich glaubte mich überall vor der Hand bestimmter Aeusserungen über die Natur der Thätigkeit in den Versuchen des grossen Entdeckers [Humboldt] enthalten zu müssen, um so unvermerkt mancher Wahrheit geneigtes Gehör zu verschaffen, vor der mancher sich, (aus leicht zu errathenden Gründen) beym Anblick des Wortes: *Electricität* vielleicht verschlossen hätte".

German experimenter and the experienced, authoritative Italian physicist. But nothing of this kind was going to happen, and it was certainly Ritter's fault that his letter was *not* – as he had probably imagined – the beginning of a fruitful dialogue. As in many similar situations, Ritter was unable to estimate the practical consequences of his initiative. Even if Volta was willing to read Ritter's letter, he simply was not able to do so. The first obstacle was Ritter's illegible handwriting in Gothic characters. In the Volta papers, there is a copy of the letter in Latin characters, and according to the editors, that copy probably dates from Volta's time. Thus it seems that Volta was so interested in Ritter's letter that he had asked somebody to transcribe it into legible writing. It is true that Volta was used to reading German, but unfortunately there is an enormous difference between normal German and Ritter's German. Even German readers have problems with Ritter's abstruse style and his endless subordinate clauses; and Ritter himself once confessed that he understood the French translations of his texts better than his own prose.[20] At the end of the letter, he apologised to Volta for writing in his native language with the argument that "the topic of this letter would have made a translation so difficult, that I believe it was to the advantage of a better understanding to write it in German".[21]

The result was exactly the contrary of what he had intended, and if Volta ever tried to penetrate into Ritter's prolixity, he must have come to the same conclusion as the editors of his papers with regard to a typical passage of that romantic physicist: "Non è di chiaro significato".[22] Whatever Volta may have thought about Ritter in 1798, according to all evidence, for reasons of calligraphy and style he was unable to understand his letter and hence he did not reply to it.

As a permanent reader of the *Annalen der Physik*, Volta knew about Ritter's work during the next few years: the discovery of the ultraviolet rays in the sunlight spectrum in 1801, and the electric accumulator (secondary charging battery, or storage pile) in 1803. In the same year, Volta began his correspondence with Gilbert, and in his first letter to Volta, in an allusion to the description of Ritter's latest discovery, the editor of the *Annalen der Physik* praises Ritter's as a "scrupulous and exact observer". In Volta's answer, we find a long, thorough discussion of Ritter's results,[23] and since Gilbert published this letter in his *Annalen*, it must have come to Ritter's attention. From a letter by Volta to Pietro Cossali, we know that Volta admired Ritter as an experimenter. In a description of the "bella sperienza [...] pubblicata […] dal Sig. Ritter di Jena", he gave an account of the storage pile.[24] Although he repeated what he had already written to Gilbert – that he did not agree with Ritter's theory of the "pila secondaria" – there can be no doubt that he considered Ritter as an important and talented physicist.

[20] See MEYER (1920), p. XXXI.
[21] *VE*, III, 1095, p. 406.
[22] *Ibid.*, p. 389.
[23] VOLTA (1803), pp. 243-4.
[24] Volta to Pietro Cossali [June 1, 1804], in *VE*, IV, 1403, pp. 353-5, see p. 354.

A proof of this positive judgement is given by the fact that one year later, in July 1805, Volta suggested that Napoleon might consider Ritter as a candidate for the next electricity prize of the *Institut National de France*.[25]

As already mentioned, Ritter focussed on occult sciences like rhabdomancy after he had gone to Munich in 1805. Volta did not appreciate this turn of Ritter's interests, and we find a condescending remark about this new field of research of his German colleague in a letter to Angelo Bellani of July 1807, where he is asking for all kinds of scientific news, "with the exception of rhabdomancy, which I allow to make noise in Germany with Ritter and Amoretti, and acquire new proselytes".[26]

Five months later, Ritter visited Volta at his home in Como. Both of them remembered this meeting as an occasion for fruitful and stimulating discussions about physical problems. According to Ritter, Volta showed him some experiments that were casting doubts upon Coulomb's law of electrostatic attraction,[27] whereas Volta recalled their agreement in nearly all points, including the theory of the secondary pile.[28] As for Ritter's tendency towards fanciful speculations, Volta takes it rather calmly, especially compared to the excessive critique that Gilbert was going to express a year later in the letter quoted above. Volta liked Ritter's "beautiful views based on new experiments", but he also clearly recognised the weak points in the ideas of his German visitor: "In one word his views are too transcendent, he runs and pushes things too far".[29]

It is typical of the high estimation that Ritter enjoyed outside Germany that Volta qualified him as "the famous Ritter who was first a professor in Jena and who became a resident member of the academy of Munich two years ago".[30] Ritter had signed his letter of 1798 as "der Natur-Wissenschaften Beflissener" (a student of natural sciences), and he had never advanced above this level. Far from becoming a professor in Jena, he had withdrawn from the university register in 1804 without any academic degree.[31]

Volta was neither interested in nor influenced by the intellectual movement of *Naturphilosophie* that divided the German physics community around 1800. The only physicist of this group with whom he was acquainted was Johann Wilhelm Ritter. Although Volta strictly refused Ritter's speculative approach to experimental

[25] Ritter, letter to Ørsted [Sept. 6, 1805], in HARDING (1920), II, pp. 125-30, see p. 125.
[26] Volta to Angelo Bellani [Aug. 14, 1807], in *VE*, V, 1543, pp. 92-4, see p. 94: "fuorché di Rabdomanzia, la quale lascio che faccia strepito ora in Germania con Ritter, e Amoretti, e faccia nuovi adepti".
[27] ØRSTED and RITTER (1808), pp. 375-6.
[28] VOLTA (1807?), p. 271. The date (1804) indicated in *VO* is wrong, since Ritter visited Volta in December 1806, the letter must be from 1807.
[29] *Ibid.*: "Insomma le sue viste sono talvolta troppo trascendenti, e corre, e spinge troppo le cose".
[30] *Ibid.*
[31] Ritter, letter to Ørsted [May 1, 1804], in HARDING (1920), II, pp. 63-8, see p. 63.

science and agreed with Gilbert's critique of Ritter's turn to occult sciences after 1805, he acknowledged the importance of Ritter's early discoveries, and his judgement about the young and talented visionary from Jena and Munich was much milder than the opinions of Ritter's compatriots like Gilbert and Pfaff.

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